Indian Journal of Agricultural Sciences **88** (1): 70–3, January 2018/Article

Effect of pre and post emergence herbicides for weed management in bermuda grass (*Cynodon dactylon*) var. Tif dwarf 419

BABITA SINGH[1], S S SINDHU[2], ROHIT PINDER[3], HARENDRA YADAV[4], NAMITA[5] and T K DAS[6]

ICAR-Indian Agricultural Research Institute, New Delhi 110 012

Received: 24 April 2017; Accepted: 05 September 2017

ABSTRACT

Turf grasses are the plants which form a continuous ground cover and is the assurance of a lush, high-quality lawn but the presence of weeds during green establishment can reduce growth and turf quality. Field experiment was conducted to investigate efficacy of Pendimethalin (1.0 kg a.i./ha) – pre emergence, Atrazine (1.0 kg a.i./ha) – pre emergence, Carfentrazone (30 g/ha)- post emergence (40 DAS), Metribuzin (300 g/ha) – pre emergence, Pendimethalin (0.75 kg/ha) + Metribuzin- pre emergence, Pendimethalin (Pre emergence) + Carfentrazone- (Post emergence), Pendimethalin (Pre emergence) + Metribuzin (Post emergence), Atrazine (Pre emergence) + Carfentrazone (Post emergence), Atrazine (Pre emergence) + Metribuzin (Post emergence), manual weeding (four hand weeding) on the establishment of Tif dwarf 419 Bermuda grass from sprigs. The results suggest that application of Pendimethalin @ 0.75 l/ha (pre-emergence) + Carfentrazone @ 0.0225 kg/ha (post-mergence) at 40 days after sowing was effective for controlling the weeds followed by Atrazine @ 0.75 l/ha (pre-emergence) + Carfentrazone @ 0.0225 kg/ha (post-emergence) at 40 days after sowing. Carfentrazone (30g/ha) alone as post emergence herbicide recorded about 75% weed mortality.

Key words: *Cynodon dactylon*, Herbicide, Tif dwarf-419, Weed

The turf grasses belong to the family Poaceae that can withstand frequent clipping of shoots and has the capacity for unlimited growth which forms a continuous ground cover and is the assurance of a lush, high-quality lawn. Bermuda grass (*Cynodon dactylon* L.) is the most widely used turf grass in full-sun areas. They are adapted to the humid and semi-arid tropical, sub-tropical and warmer temperate regions in the world. With potential for water savings and many desirable qualities fitting today's turf grass needs and environmental concerns, Bermuda grass use has increased considerably (Keeley and Fagerness 2001). *Cynodon dactylon* is a highly variable warm season turf grass species, containing considerable variation in colour, texture, density, vigour and environmental adaptation (Turgeon 2005). Bermuda grass is widely used on athletic fields, bowling greens, tennis courts, golf courses and home lawns. Weeds decrease the aesthetic value and the usability of turf grass. In addition to being unsightly, weeds compete with turf grasses for light, oxygen, soil nutrients, soil moisture, carbon dioxide and space. Weeds also act as hosts for pests such as plant pathogens, nematodes and insects. Certain weeds cause allergic reactions in humans due to their pollen or their volatile chemicals. Probably the most undesirable characteristic of weeds in turf is the disruption of the uniformity of a turf. Different leaf width and/or shape, different growth habit, and/or different colour contribute to unsightliness. In addition, large clumps are difficult to mow effectively and they increase maintenance problems. Turf uniformity also disrupted by weed seed heads. These seed heads also disrupt the smoothness and trueness of the turf's playing surface. Plant colour is another factor in determining the potential of a weed problem in turf (McCarty 1993).

Weeds, of all situations, are adapted for not only bad agronomic conditions, but they are also adapted to thrive under excellent agronomic conditions (Busey 2003). Changing agronomic practices to reduce the competitiveness of one weed simply shifts the weed problem to another species. It is because of the omnipresent nature of weeds that herbicides are used. Herbicides are a vital and necessary component for turf grass weed management. A mode of action is the physiological or biochemical mechanism by which an herbicide kills or injures plants (Senseman 2007). Selective herbicides have four main groups that targeted weeds, viz. broadleaf (dicots), grasses (monocots), sedges (monocots), and other non-grass monocots (Mcelroy and Bhowmik 2013). There are many stadiums, parks, hotels, office complexes, shopping malls in Delhi where turf grasses are indispensable part of city life as they contribute to the

[1]Scientist (e mail: bflori17feb@gmail.com), [2]Head (e mail: sssindhu2003@yahoo.co.in), [3]SRF (e mail: rohitpinder69@gmail.com), [4]Technical (harendrahort@gmail.com), [5]Scientist (e mail: namitabanyal@gmail.com), Division of Floriculture and Landscaping, [6]Principal Scientist (tkdas64@gmail.com), [6]Division of Agronomy, ICAR-IARI.

aesthetic beauty and environmental benefit of the areas and activities. The information on turf grass weed management is meager in India, therefore the present study was conducted to find out the suitable herbicide combinations that will provide the weed free turf grass or lawn for Delhi conditions.

MATERIALS AND METHODS

The study was carried out at the Research farm of the Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi during 2015-2017. The area is semi arid with continental climate characterized by hot summers and cold winters. Warm season turf grass, *Cynodon dactylon* var. Tif dwarf 419 was used for the experiment. This variety was collected through National Bureau of Plant Genetic Resources, New Delhi. Grass sprigs were dibbled on raised beds of 2 × 2 m^2 beds during month of July 2014. Basal dose of DAP: MOP (2:1) @ 50 g/m^2 was applied at the time of planting. Pre emergence herbicides were applied with established turf grass site prior to weed seed germination, i.e. post planting (Turf grass) pre emergence (weed) application while post emergence herbicides were applied 40 days after pre emergence herbicide application using a knapsack sprayer fitted with flat fan nozzle. Treatments include T_o- Control, T_1- Pendimethalin (1.0 kg a.i./ha) – pre emergence, T_2- Atrazine (1.0 kg a.i./ ha) – pre emergence, T_3- Carfentrazone (30 g/ha)- post emergence (40 DAS), T_4- Metribuzin (300 g/ha) - pre emergence, T_5- Pendimethalin (0.75 kg/ha) + Metribuzin- pre emergence (tank mix), T_6- Pendimethalin (pre emergence) + Carfentrazone (post emergence), T_7- Pendimethalin (pre emergence) + Metribuzin (post emergence), T_8- Atrazine (pre emergence) + Carfentrazone (post emergence), T_9- Atrazine (pre emergence) + Metribuzin (post emergence) and T_{10}- manual weeding (four hand weeding). Data were recorded on various morphological traits such as weed emergence (days), fresh weight of weed (g), dry weight of weed (g), fresh weight of turf root (g), dry weight of turf root (g), fresh weight of turf shoot (g), dry weight of turf shoot (g) and weed mortality (%). Fresh weight and dry weight of weeds were taken from 4 m^2 area and recorded after 20 days interval (for pre emergence treatment only) and weed mortality were taken for pre emergence combination with post emergence treatments. The root and shoot fresh weight and dry weight of turf were taken from 100 cm^2 area in morning hours and dried in hot air oven at 60ºC for 72 hr and dry weight recorded. The experiment was laid out in randomized block design with three replications. Differences were considered significant at 5% level of significance.

RESULTS AND DISCUSSION

Effect on weed growth

Turf grass var. Tif. Dwarf 419 was infested with *Cyperus rotundus, Commlina cynotis, Corchorus acutangulus, Echinoclova colona, Eclipta alba, Euphorbia hirta, Convolvulus arvensis, Dactylotenium aegypticum, Sporobolus diander, Trianthema portulacastrum* and *Phyllanthus niruri* due to their frequent occurrence. The occurrence of the other weed species was sporadic with low density.

The data presented in Table 1 reveal that application of herbicides plays very significant role on the days to weed emergence and application of herbicide did not affect the turf grass significantly. Maximum effect of herbicide treatment on the duration of weed emergence were observed with T_5 (16.50 days), Pendimethalin (pre-emergence) + Metribuzin (pre emergence) while lowest effect was recorded with treatment T_0 (4.50 days) in control. All the herbicide treatments (T_1 – T_9) resulted in significant reduction of emergence of weeds as compared to manual weeding (T_{10}).

Fresh weight (24.48 g/4m^2) and dry weight (9.18 g/4m^2) of weeds were significantly lower when treated with treatment T_5 [Pendimethalin (0.75 kg/ha) + Metribuzin- pre emergence (tank mix)]. However, maximum fresh weight (85.00 g/4m^2) and dry weight (27.85 g/4m^2) were recorded in control.

Pre-emergence herbicides generally are applied to an established turfgrass site prior to weed seed germination. This group of herbicides controls weeds during the germination process. Pre emergence herbicides are applied to the turfgrass site prior to weed seed germination. The mode of action for most pre emergence herbicides is the inhibition of certain phases of cell division (mitosis) or inhibition of cell elongation. As the weed seedling germinates, its root and shoot absorbs the herbicide, stops growth and eventually dies (Engel and Ilnicki 1969).

Pendimethalin is an emulsifiable concentrates (ec) which is oily (non-polar) liquids that form emulsions in water (polar). The emulsifying agent acts as a binder coupler between the oil-water surfaces. It reduces interfacial tension and allows the tiny droplets to remain in suspension. Emulsions are milky-colored and require agitation to keep the herbicide uniformly suspended in the spray tank.

It belongs to di-nitro aniline group and controls both,

Table 1 Effect of pre-emergence and post -emergence herbicide on weed growth

Treatment	Weed emergence (days)	Fresh weight of weed (g)	Dry weight of weed (g)
T_0	4.50	85.00	27.85
T_1	13.50	30.78	11.31
T_2	13.33	39.38	16.57
T_3	5.00	0.00	0.00
T_4	7.33	68.87	21.44
T_5	16.50	24.48	9.18
T_6	14.33	0.00	0.00
T_7	14.33	0.00	0.00
T_8	14.67	0.00	0.00
T_9	13.17	0.00	0.00
T_{10}	0.00	0.00	0.00
CD (P=0.05)	0.79	2.00	1.28

narrow and broad leaf weeds. It is a selective herbicide to be used before emergence of weeds and crops. After application of Pendimethalin, a thin layer is formed at soil surface which prevents the germination of weeds. Its primary mode of action is to prevent plant cell division and elongation in susceptible species (Weber 1990) while Metribuzin a wettable powders (wp) which is finely ground solids consisting of a dry diluents (usually a hydrophilic clay) plus the herbicide and various adjuvant. Metribuzin is a selective herbicide of the chemical class Triazines. Metribuzin acts by inhibiting photo system II of photosynthesis by disrupting electron transfer (McCarty *et al*. 1991). Probably combined or dual action of pendimethalin and metribuzin reduced the emergence of weeds which resulted in reduced weed growth.

Effect on turf growth

The morphological traits of turf grass were significantly affected by the application of herbicides (Table 2). The data indicated that maximum fresh weight (6.65 g/m^2) and dry weight (2.47 g/m^2) of turf shoot were observed in weed-free check T_{10} which was significantly at par with T_6 and T_8. However, minimum fresh weight (2.33 g/m^2) and dry weight (0.67 g/m^2) of turf shoot were recorded in control. Similarly, significant variations were recorded among fresh weight and dry weight of turf root. Maximum fresh weight (8.10 g/m^2) and dry weight (2.75 g/m^2) of turf root were recorded in weed-free check T_{10} which was significantly at par with T_6 (pendimethalin-pre emergence + carfentrazone-post emergence) and T_8 (atrazine-pre emergence + carfentrazone-post emergence). However, minimum fresh weight (4.13 g/m^2) and dry weight (1.39 g/m^2) of turf root were recorded in control.

Application of pendimethalin (pre-emergence) reduced the germination of both broad leaf and annual grass weeds and atrazine (pre emergence) function by binding the plastoquinone-binding protein in photo system II, which causes starvation and oxidative damage by breakdown in the electron transport process and ultimately plant death (Appleby *et al.* 2001). Singh and Singh (2010) observed similar reduction in weed growth due to herbicides in direct-seeded rice. Carfentrazone is a contact herbicide used to control broad-leaf and sedge weeds in cereals as post emergence. It belongs to triazolinone group absorbed through the leaves when applied as a foliar spray. Its translocation after absorption is limited. The mode of action of carfentrazone-ethyl is the disruption of membranes by inhibiting the action of protoporphyrinogen oxidase (PPO), causing cell death (Bhullar *et al*. 2013).

Carfentrazone-ethyl is a post-emergence herbicide for control of broadleaf and narrow leaf weeds in a variety of agricultural crops, turf, industrial and utility sites (Ilango 2003). Covarelli and Stagnari (2002) observed similar results in wheat.

Highest weed mortality (84.67 %) was recorded in the plants treated with pendimethalin (pre emergence) + carfentrazone- (post emergence) (T_6) which was significantly higher than T_8. However, weed mortality (74.17%) was recorded with carfentrazone (30 g/ha) - post emergence (40 DAS) (T_3). Post emergence herbicides are effective only on germinated and visible weeds. The application should be when weeds are young, preferably during the two-to-four leaf stage as herbicide uptake and translocation is favoured at this stage. Turf grasses also are then better able to fill in voids left by the dying weeds (Willard and Currey 1985). There is no weed mortality where Metribuzin was applied as a post emergence herbicide (Table 2). Metribuzin was the least effective post emergence herbicide against narrow leaved weeds as reported by Ali (2011) in wheat.

Table 2 Effect of pre-emergence and post-emergence herbicide on *Cynodon dactylon* var. Tif dwarf-419

Treatment	Fresh weight of turf shoot (g/m^2)	Dry weight of turf shoot (g/m^2)	Fresh weight of turf root (g/m^2)	Dry weight of turf root (g/m^2)	Weed mortality (%)
T_0	2.33	0.67	4.13	1.39	0.00
T_1	5.80	1.93	7.47	2.47	0.00
T_2	5.28	1.48	6.50	2.14	0.00
T_3	2.33	1.08	4.19	1.52	74.17
T_4	3.37	1.09	4.73	1.58	0.00
T_5	5.43	1.82	6.92	2.28	0.00
T_6	6.37	2.34	8.03	2.68	84.67
T_7	5.95	2.05	7.52	2.53	0.00
T_8	6.20	2.15	7.73	2.59	79.50
T_9	5.33	1.52	6.66	2.17	0.00
T_{10}	6.65	2.47	8.10	2.75	0.00
CD (P=0.05)	0.28	0.15	0.57	0.19	0.69

From the present investigation, it can be concluded that application of carfentrazone (@ 0.0225 kg/ha as post-emergence at 40 days after sowing in combination with pendimethalin @ 0.75 lit /ha as pre emergence) followed by atrazine @ 0.75 kg/ha as pre emergence resulted in effective weed control and better quality of turf grass**.** However, carfentrazone (30 g/ha) alone as post emergence herbicide recorded 75% weed mortality.

REFERENCES

Ali M. 2011. Effect of post emergence herbicides on narrow leaved weeds in wheat crop. National Agricultural Research Centre, Pakistan Agricultural Research Council, Islamabad, Pakistan.

Appleby Arnold P and Muller Franzand Carpy Serge. 2001. Weed control. (*In*) *Ullmann's Encyclopedia of Industrial Chemistry.* doi:10:1002/14356007.a28_165.

Bhullar M S, Simerjit Kaur, Tarundeep Kaur, Tarlok Singh, Megh Singh and Amit J Jhala. 2013. Control of broadleaf weeds with post-emergence herbicides in four barley (*Hordeum spp*.) cultivars. *Crop Protection* **43**: 216–22.

Busey P. 2003. Cultural management of weeds in turfgrass. *Crop Science* **43**: 1899–1911.

Covarelli G and Stagnari F. 2002. Carfentrazone-ethyl for post-emergence weed control in wheat [*Triticum aestivum* L.]. *Atti*

delle Giornate Fitopatologiche **1**: 183–8.

Engel R E and R D Ilnicki. 1969. Turf weeds and their control. (*In*) *Turfgrass Science,* pp 240-87. Hanson A A and Juska F V (ed.). American Society of Agronomy Madison, Wisconsin.

Ilango R V J. 2003. Evaluation of carfentrazone-ethyl for control of weeds in tea (*Camellia* spp.). *Indian Journal of Weed Science* **35**: 296–7.

Keeley S and M J Fagerness. 2001. Buffalo grass lawns. Horticulture Report MF-658, Kansas State University Cooperative Extension Service.

McCarty L B, Miller L C and Colvin D L. 1991. Bermuda grass (*Cynodon* spp.) cultivar response to Diclofop, MSMA, and Metribuzin. *Weed Technology* **5**: 27–32.

McCarty L B. 1993. Weed identification and control. University of Florida's pest control recommendations for turfgrass managers. SS-ORH-004 SS-ORH-004, University of Florida Cooperative Extension Service.

Mcelroy J S and Bhowmik P C. 2013. Weed management in turf grass. *Turf grass Monograph* ASA-CSSA-SSSA (*In Press*).

Senseman S A. 2007. *Herbicide Handbook*, 9 ed, p 217. Weed Science Society of America, Lawrence.

Singh M and Singh R P. 2010. Efficacy of different methods of direct-seeded rice (*Oryza sativa* L.) establishment. *Indian Journal of Agricultural Sciences* **80**(9): 815–900.

Turgeon A J. 2005. Turfgrass species. *Turfgrass Management*, *7th Edition*, pp. 59-119. Pearson Education, Inclusive, Upper Saddle River, New Jersey.

Weber B J. 1990. Behavior of dinitroaniline herbicides in soils. *Weed Technology*: 394–406.

Willard T R and W L Currey. 1985. Selectivity of post emergence grass herbicides in warm-season turfgrass. *Proceedings-Southern Weed Science Society* **38**: 96.